CENTER ROUTING SLIP

FROM			DATE
IEG			12/22

TO		INITIALS	DATE	REMARKS
DIRECTOR	2	acl	12/28	Mr. Lundahl –
DEP DIRECTOR				On 18 Nov you asked for feed back on this meeting," its scope, speakers, displays used, etc."
EXEC/DIRECTOR				
SPECIAL ASST				
ASST TO DIR	1	WJJ	12/22	[redacted] has done a rather comprehensive job on all counts!
HISTORIAN				
				Bill
CH PPBS				
DEP CH PPBS				
EXO PPBS				
				WALLY L 12/27/71
CH SS				
DEP CH SS				Keep this in my classified personal use file. acl.
SC & P				
RECORDS MGT				
PERSONNEL				
LOGISTICS				
TRAINING				
SECURITY				
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CH/DIAXX-4				
CH DIAAP-9				
CH/SPAD				

25X1

IP FORM 30 (7 70) OBSOLETE PREVIOUS EDITIONS

25X1

MEMORANDUM FOR: [redacted]

Wally:

I have left attached some notes from Tom Logan answering questions I put to him about this symposium.

12/29
(DATE)

FORM NO. 101 REPLACES FORM 10-101

CY DEC

AEM:

[redacted] TELLS ME HE SPECIFICALLY APPROVED [redacted] [redacted] ATTENDING THE PATTERN RECOGNITION SYMPOSIUM. HE DID THIS EVEN THOUGH [redacted] [redacted] WOULD BE ATTENDING BECAUSE HE FEELS THAT BOEING HAS A UNIQUE AND VALUABLE HUMAN FACTORS POINT OF VIEW AT SUCH AFFAIRS. PAUL DID NOT KNOW THAT I WOULD BE ATTENDING, BUT SAID THAT THIS WOULD NOT HAVE CHANGED HIS DECISION. PAUL SAYS HE NORMALLY APPROVES SOMETHING LESS THAN HALF OF [redacted] CONFERENCE COVERAGE RECOMMENDATIONS.

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PAUL EXPECTS [redacted] TO SUBMIT HIS REPORT OF THE

25X1

CONFERENCE EARLY IN JANUARY. PAUL WILL BUCK ME A COPY.

I EXPECT SHORTLY TO KNOW A LOT MORE ABOUT [redacted] 25X1
THAN I DID YESTERDAY. I HAVE BEEN ASKED TO DRAW TOGETHER IEG's ASSESSMENT OF [redacted] 25X1
PERFORMANCE ON THE FY-69 CONTRACT. THIS IS IN CONNECTION WITH THE AWARD FEE DETERMINATION, AND IS DUE 8 JAN.

[redacted] 25X1 ADDITIONAL COMMENT IS TO SAY THAT BUT FOR SECURITY, THE HONEYWELL AND ESPECIALLY THE LITTON PAPER WOULD HAVE BEEN MUCH BETTER.

TAC.

29 DEC 10

JOHN:

THIS IS MY REPORT OF THE P.I. SYMPOSIUM 1-2 DECEMBER. IT HAS ALREADY BEEN UP TO O/DIR. [redacted] ASKED ME TO SHOW IT TO YOU AND TO ASK FOR ANY ADDITIONAL COMMENT THAT YOU MIGHT WANT TO MAKE. 25X1

WHEN YOU ARE FINISHED WITH THIS REPORT PLEASE LET ME HAVE IT BACK SO THAT I CAN PASS IT ON TO [redacted] 25X1

[redacted] 25X1

[redacted] 25X1

Atem- M

Suspend for WJF
23 Dec
(OVR
Done 12/22

[redacted] is preparing a "voluminous report" on the symposium which he believes will be done (in rough) by Friday. However, Tom says the typing problem in IEG may move the final draft back one more week. In addition, the in-basket problem that haunts IEG will probably tack on another two weeks.

25X1

[redacted] does not plan to prepare a report although his point of view (which would obviously be different than Tom's) probably should be presented.

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I suggest we suspend this until 22 December in the case of IEG's contribution and get back to [redacted] with the word that he is exempted to

25X1

to prepare a report on the proceedings.

wjf

WJF

Tell Tom to do himself and me a favor and make it facts based.

AJ

MEMORANDUM FOR: NJF

BJH:

Two people attended this I believe. Find out when we can expect a report.

[redacted] report will be done this week – typing is another matter

12/8
(DATE)

FORM NO. 1 AUG 54 101 REPLACES FORM 10-101

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Sanitized Copy Approved for Release 2010/05/11 : CIA-RDP80T01137A000200040001-4

CENTER ROUTING SLIP

FROM		DATE
R+RD/IB/RSS 4N415		10 November

TO		INITIALS	DATE	REMARKS
DIRECTOR	2	OCL	11/18	FYI
DEP/DIRECTOR				
EXEC/DIRECTOR				
SPECIAL ASST	1	M	11/17	This symposium may be of interest to you.
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ASST TO DEP/DIR				
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DEP CH/PPBS				
EO/PPBS				
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EO/IEG				
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CH/TSSG	3			⊖ would like some
DEP CH/TSSG				good feedback on
EO/TSSG				this meeting - scope,
CH/SSD/TSSG				speakers, displays
PERSONNEL				used, effectiveness,
LOGISTICS				future plans/prospects,
TRAINING				etc.
RECORDS MGT				
SECURITY				CICL.
FINANCE				
DIR/IAS/DDI				
CH/DIAXX-4				
CH/DIAAP-9				
CH/SPAD				

Suspend: 7 Dec

11/18 - Gave to Abernathy to coordinate comments.

25X1

IP FM 30 (11-68) - OBSOLETE PREVIOUS EDITIONS

Electronic Industries Association. Weekly Report

Photointerpretation Symposium Set

A wide-ranging review of developments in photointerpretation and recognition will be aired at a symposium to be sponsored by EIA's Government Products Division's Defense Communication Council Committee on Automatic Imagery Pattern Recognition.

Under the chairmanship of George D. Swanlund, Honeywell Inc., the symposium will be held at the Westinghouse Defense and Space Center in Baltimore on Dec. 1 and 2. It is an outgrowth of a series of automatic target recognition contract review meetings which were held during previous years.

Sponsorship by EIA, which began this year, will support the effort to advance recognition technology in the present austere research environment.

The stated goal of the symposium, according to Dr. Glen E. Tisdale of Westinghouse, who is serving as facilities chairman, is to bring together scientists involved in current technical developments with the people who can guide the application of these developments to pressing needs.

Professor Azariel Rosenfeld, of the University of Maryland Computer Science Center, is serving as program chairman. He has arranged four sessions of invited papers on current developments in industry, the universities, and government.

Papers will deal with the automatic analysis of pictorial data obtained by remote sensors. Both military and environmental sciences applications will be covered. All sessions will be unclassified.

Professor Laveen Kanal, the keynote speaker also of the University of Maryland Computer Service Center, will provide an overview of the state-of-affairs in the area of image processing and recognition.

Registration fee of $20 should be made payable to the EIA Symposium on Automatic Photointerpretation. The program begins at 9 a.m., Dec. 1 in the auditorium of the Administration building at the Defense and Space Center.

Additional information on the program will be published in the *Weekly Report* within the coming weeks.

MEMORANDUM FOR: Director, NPIC

Mr. Lundahl

Believe you will be interested in the attached abstracts of presentations made at the Westinghouse Automatic Photointerpretation Recognition Symposium, Dec 1 & 2 together with [redacted] candid comments.

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[redacted]

(DATE)

FORM NO. [illegible] REPLACES FORM [illegible]

IEG/OD/TPB-164/70
14 December 1970

MEMORANDUM FOR: Chief, Imagery Exploitation Group, NPIC

THROUGH : Chief, Technical Planning Branch, OD

SUBJECT : Report of the Symposium on Automatic Photo-interpretation and Recognition

1. December 1 and 2, the latest in what has become a series of annual symposia on automatic photointerpretation and recognition was held at the Westinghouse Defense and Space Center, Baltimore, Maryland. The meeting attracted some 125 persons, representing a variety of government, business, and academic interests. A partial list of attendees is included as the first attachment.

2. NPIC and CIA were well represented at this gathering. [redacted] the TSG/RED officer responsible for NPIC's current ATR development effort with [redacted] attended, as well as [redacted] who covered the conference as part of the [redacted] human factors contract. Also, [redacted] a charter member of the Electronic Industries Association, the chairman of the subcommittee on symposia, and an ostensible U.S. Army civilian employee, is actually a DDS & T/ORD officer. A glance at the list of attendees will show that other Agency employees, contractors, or consultants may have been there as well.

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3. Overall, there seemed to be disappointment among long-term attendees over the selection and content of the papers presented. Perhaps this was because so many papers concentrated on relatively obscure aspects of the mathematics of pattern recognition, or with methods of dealing with this math with computers. Decidedly in the minority were papers concerning pattern recognition systems or hardware in actual use or contemplated for early development.

4. For convenience, I have numbered the presentations and abstracts in the program, and have interleaved my comments so that they

IEG/OD/TPB-164/70
9 December 1970

SUBJECT: Report of the Symposium on Automatic Photo-interpretation and Recognition

appear on the page facing the abstract. In many cases, the presentation of the paper added little to my comprehension of the topic, so I have no additional comment to make.

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IEG/OD/TPB

Attachments:
a. List of Attendees
b. Program Abstracts--Symposium on Automatic Photointerpretation and Recognition.

Distribution:
Orig. & 1 - Addressee
1 - NPIC/IEG/OD
1 - NPIC/IEG/OD/TPB

Next 4 Page(s) In Document Denied

SYMPOSIUM ON

AUTOMATIC

PHOTOINTERPRETATION

AND RECOGNITION

PROGRAM—ABSTRACTS

SPONSOR: GOVERNMENT PRODUCTS DIVISION

ELECTRONIC INDUSTRIES ASSOCIATION

WESTINGHOUSE DEFENSE AND SPACE CENTER

BALTIMORE, MARYLAND

DECEMBER 1 AND 2, 1970

SYMPOSIUM ON

AUTOMATIC PHOTOINTERPRETATION AND RECOGNITION

PROGRAM - ABSTRACTS

SPONSOR: GOVERNMENT PRODUCTS DIVISION
ELECTRONIC INDUSTRIES ASSOCIATION

WESTINGHOUSE DEFENSE AND SPACE CENTER
BALTIMORE, MARYLAND

December 1 and 2, 1970

Sanitized Copy Approved for Release 2010/05/11 : CIA-RDP80T01137A000200040001-4

TABLE OF CONTENTS

The EIA DCC Committee on Automatic Imagery Pattern Recognition takes pleasure in welcoming you to this Symposium on Automatic Photointerpretation and Recognition. We hope that you will share in the excitement and in the development of this field. It is certainly one of the most promising technologies under development. It offers challenges in theory, analysis, and implementation which appear to be unlimited. At the same time, its development marks the beginning of a continual progression to automate man's interpretation and recognition processes of remotely sensed data. Thus it is a key to the fast and efficient exploitation of imagery data from many military and environmental sciences applications.

It is our intent to preserve the same informality and up-to-date reporting that existed at the ATR Contract Review Meetings; that is, reports on what investigators are doing, and what they are going to do, rather than a presentation of the final results from a program completed a year or more earlier. For this first meeting under EIA sponsorship, Prof. Azriel Rosenfeld has brought together people involved in current efforts with others who have done outstanding work in the past. The papers describe the development of new techniques, as well as the needs to which these techniques will be applied.

Please exercise your right and privilege in participating with the group, and in getting to know others in this field. This function is as important to our Symposium as the technical presentations.

George Swanlund

George D. Swanlund
Chairman

Honored Guest!

We are fortunate to have Brig. Gen. Robert T. Marsh, Deputy for Reconnaissance and Electronic Warefare, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, as a featured speaker.

Gen. Marsh is responsible for directing the development and acquisition of Air Force aeronautical reconnaissance and electronic warfare systems, subsystems, and equipment. He has been in his present position since September, 1969. Previously, he was executive officer to the Deputy Chief of Staff for R and D, USAF, in Washington, D. C.

Committee on Automatic Imagery Pattern Recognition

Defense Communications Council

of the

EIA Government Products Division

Charter Members

George D. Swanlund, Honeywell Inc., Committee Chairman
Claron W. Swonger, Cornell Aero. Lab., Chairman, Subcommittee on Current State of Technology and Technology Needs
Bernard B. Scheps, USAETL, Chairman, Subcommittee on Application Needs
Robert M. Haralick, Univ. Kansas, Chairman, Subcommittee on Definitions and Standards
Robert H. Asendorf, U.S. Army, Chairman, Subcommittee on Symposia
William H. Moore, EIA Staff Vice President, Govt. Products Div.
Selby Evans, Texas Christian Univ.
R. Gerharz, USANVL
Ronald P. Grosso, Perkin-Elmer Corp.
Thomas Harley, Jr., Philco-Ford Corp.
Guy F. Hays, USAECOM
R. David Joseph, McDonnell-Douglas Corp.
John S. Maier, RADC
Col. Robert W. Morgan, USAF(AFRDR)
Lawrence P. Murphy, USAETL
Charles W. Nyquist, Headquarters USAF(AFNIN)
Azriel Rosenfeld, Univ. of Maryland
W. J. Sacco, USA-BRL
Robert A. Strasser, USAF-Avionics Labs.
Glenn E. Tisdale, Westinghouse Defense and Space Center
John R. Vogler, DIA
James E. Wasielewski, RADC
Norman Sharp, EIA Staff

Participation by qualified organizations is welcomed.

SYMPOSIUM COMMITTEE

Dr. Robert H. Asendorf, Chairman
Prof. Azriel Rosenfeld, Program
Dr. Glenn E. Tisdale, Facilities

Our appreciation is extended to the management of the Westinghouse Defense and Space Center for the generous use of their facilities.

PROGRAM

Tuesday, December 1

8:30 AM Registration

MORNING SESSION

Chairman: Glenn E. Tisdale
Westinghouse, Baltimore, Md.

9:00 AM Greetings
John W. Stuntz, Vice President, Westinghouse Defense and Space Center, and General Manager, Systems Development Division, Baltimore, Md.

(1) 9:15 AM Keynote Address
Laveen N. Kanal, University of Maryland, College Park, Md.

(2) 10:00 AM "Potential applications of pattern recognition techniques in the EROS program", William A. Fischer, U.S. Geological Survey, Washington, D.C.

10:30 AM Coffee

(3) 11:00 AM "A model for optimizing the effectiveness of man-machine decision making in a pattern recognition system", R. M. Fenker and S. H. Evans, Texas Christian University, Ft. Worth, Texas

(4) 11:30 AM "An iterative clustering procedure", Robert M. Haralick and Its'hak Dinstein, University of Kansas, Lawrence, Kansas

(5) 12:00 N "Optimal Fourier domain data compaction for earth resources satellite data", Harvey F. Silverman, IBM, Yorktown Heights, N.Y.

12:30 PM Lunch

AFTERNOON SESSION

Chairman: Azriel Rosenfeld, University of Maryland, College Park, Md.

(6) 1:30 PM "On the application of pattern recognition techniques to some remote sensing problems", K. S. Fu, Purdue University, Lafayette, Ind.

(7) 2:00 PM "The use of correlated spectral imagery in two bands for the extraction of agricultural information", Robert E. Kinzly and John E. Walker, Cornell Aeronautical Laboratory, Buffalo, N.Y.

2:30 PM Coffee

(8) 3:00 PM "Applications of Golay hexagonal pattern transforms to aerial reconnaissance image processing", Kendall Preston, Jr., Perkin-Elmer, Norwalk, Conn.

(9) 3:30 PM "A context algorithm for pattern recognition and image interpretation", John R. Welch and Kenneth G. Salter, Philco-Ford, Willow Grove, Pa.

(10) 4:00 PM Tour of Westinghouse sensor system projects

(11) 6:00 PM Social hour and buffet banquet
Friendship International Hotel

Wednesday, December 2

MORNING SESSION

Chairman: Robert H. Asendorf

(12) 9:00 AM "A learning system for terrain recognition", J. M. Idelsohn, Bendix, Southfield, Mich.

(13) 9:30 AM "A hybrid computation system for pattern classification", R. D. Joseph and S. S. Viglione, McDonnell-Douglas, Newport Beach, Calif.

(14) 10:00 AM "Multispectral recognition techniques at the University of Michigan: Present status and a planned hybrid recognition system", Robert E. Marshall and Frank J. Kriegler, University of Michigan, Ann Arbor, Mich.

10:30 AM Coffee

(15) 11:00 AM "Interactive pattern recognition", John W. Sammon and Bruce K. Opitz, Computer Symbolic, Rome, N.Y.

(16) 11:30 AM "Automatic target screening in reconnaissance systems", George D. Swanlund and Leonard Kirvida, Honeywell, St. Paul, Minn.

(17) 12:00 N "Applications of a digital image processing system", Glenn E. Tisdale, Westinghouse, Baltimore, Md.

12:30 PM Lunch

AFTERNOON SESSION

(18) TV DEMO Chairman: George D. Swanlund, Honeywell, St. Paul, Minn.

(19) 1:30 PM "Image analysis for a real terrain analysis problem -- state of the art capability and progress toward automation", E. G. Barnes, F. G. Capece, L. P. Murphy, D. G. Orr and B. B. Scheps, U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Va.

(20) 2:00 PM "Airborne target recognition -- concepts and practice", Robert A. Strasser, Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Ohio

2:30 PM Coffee

(21) 3:00 PM "Multiplexed holographic filters", James Thomasson, Litton Systems, Van Nuys, Calif.

(22) 3:30 PM "Detection of texture edges", Azriel Rosenfeld, University of Maryland, College Park, Md.

Presentation No. 1 - Keynote address by Dr. Laveen N. Kanal, University of Maryland Computer Services Center.

Dr. Kanal told the group that it must realize that the funding picture has changed drastically in the past two years. Since 1946 there has been an abundance of funds for the solution of scientific and technical problems, but this abundance ended in 1968. There are still funds, but only for well-justified goal-oriented projects. We can no longer afford to pursue parallel and complementary solution paths for pattern recognition or any other scientific problem. Therefore, pattern recognition research should proceed in an orderly fashion along a single path. It should finally be admitted that the "optical" solution to pattern recognition has been run to ground, and should be abandoned in favor of the "digital" solution.

In the question and answer period that followed, Dr. Kanal decried the ease with which dubious projects such as the SST and the ABM are still able to receive funding in spite of the tight fiscal situation. He said that it is still easier to fund a project for the collection of data than for the exploitation of data.

Presentation No. 2 - Mr. Fischer reported that the Geological Survey concluded long ago that great benefits are to be gained from applying pattern recognition techniques to USGS problems. There is every reason to believe that this will continue to be true under EROS. Some recent evidence to support this contention:

a. HUD recently asked the Geological Survey to assist in the collection of data on housing quality. A cursory inspection of the 28-item questionnaire showed only three questions that could be answered from aerial photography. One of the questions for instance was, ". . . do the gutters leak . . .? Rather than refuse the request, USGS took a second look. A researcher soon discovered that results equivalent in accuracy to a ground survey could be obtained by simply finding and correctly classifying the pattern contained in the condition of vegetation and the distribution of trash in the back yards of residences in the survey area.

b. A requirement to determine the pattern and extent of the straight-line ejecta from the moon crater tycho was satisfied by digitizing a photograph, and producing another photograph after first taking a first derivative of the digitized data.

c. Correlations have been discovered between the complexity of stream patterns and the underlying bedrock. Granite formations for instance, are found to be covered by very simple stream patterns. This information is of great value to hydrologists doing ground water studies.

d. SLAR photographs of the Ashville Basin of North Carolina have been classified into arbitrary categories of different landforms, and correlations have been discovered between the landforms and the economic condition of the inhabitants.

Mr. Fischer concluded by saying that while USGS is very interested in pattern recognition, it is in no position to fund pattern recognition research. USGS hopes to use pattern recognition techniques with EROS, and hopes that research in the field can somehow continue in the

Potential applications of pattern recognition techniques in the EROS program

William A. Fischer

U.S. Geological Survey
Washington, D. C.

In the early 1950's, attempts were made by the U.S. Geological Survey to describe quantitatively recognition elements used in photo interpretation; these are size, shape, shadow, tone and color, texture and pattern. Moderate success was achieved in this effort and in using the results to interpret facts about land forms, for example, the relative age of glacial moraines. It was also determined that the variabilities in scale, scene illumination, and vignetting inherent in wide-angle aerial photography limited the usefulness of this approach to description and interpretation of relatively small areas.

More recently automatic, quantitative analyses have been made of shadow distributions and tones in radar images and these measurements used to classify and delimit land form units in the Asheville Basin of North Carolina. These units correlate well with regional variations in economic productivities and construction costs.

Another recent experiment suggests that Fourier transformations of building and street distributions as seen in photographs may be a useful method for classifying elements of an urban scene and detecting changes therein.

With the advent of the more uniformly illuminated data acquirable from space, pattern recognition techniques should become much more useful for resources/environmental assessments than they have been in the past.

Presentation No. 3

Dr. Fenker is by training a psychologist. He reports as psychological fact that Man can correctly classify complex patterns, intuitively, and with great consistency and repeatibility. Man does this without being able to explain his decision and without making any discernible metric comparisons. Dr. Fenker hypothesizes that the best pattern recognition system would have Man do the classification, the task which he does best and most efficiently, while the machine is relied upon for repeated decisions concerning the classifications into which the data falls.

A model for optimizing the effectiveness of man-machine decision making in a pattern recognition system

R. M. Fenker and S. H. Evans

Texas Christian University
Ft. Worth, Texas

Typical pattern recognition processes can be separated into several components, some of which may be more readily automated than others. Humans seem to be particularly suited for the earlier parts of processing, such as the delineation of a part of the image to be recognized as a single object, and the adaptive selection of an effective feature space for a given task context. Optimal decision processes, on the other hand, giving due weight to prior probabilities, utilizing efficient multidimensional classification processes, and perhaps taking into account differential costs of errors - these processes can now be automated on the basis of an already well developed body of knowledge. They may be better handled by machines than by men. Recent work suggests that a reasonable model for human pattern recognition can usefully incorporate processes such as mapping an unknown pattern into a subjective feature space and classifying it on the basis of its location in that space. In terms of this model and of the above considerations, the best point to tap into the human pattern recognition process may well be at the feature space level rather than at the classification level. The present paper proposes a method for relating this subjective feature to an objective feature space of a machine so that a human could serve as preprocesser and feature analyzer while the machine could carry out the statistical classification processes.

Presentation No. 4

Nothing to add

An iterative clustering procedure

Robert M. Haralick and Its'hak Dinstein

University of Kansas
Lawrence, Kansas

In many remote sensing applications, millions of measurements can be made from a satellite at one time, and many times the data is of marginal value. In these situations, clustering techniques might save much data transmission without loss of information since cluster codes may be transmitted instead of multi-dimensional data points. Data points within a cluster are highly similar so that interpretation of the cluster code can be meaningfully made on the basis of knowing what sort of data point is typical of those in the cluster.

In this paper we introduce an iterative clustering technique. The procedure suboptimally minimizes the probability of differences between the binary reconstructions from the clusters' codes and the original binary data.

The iterative clustering technique was programed for the GE 635, KANDIDATS (Kansas Digital Image Data System) system and tested on a multi-image data set. Twelve images of the northern part of Yellowstone Park were taken by the Michigan scanner system. The images were reduced and run with the program. 30,000 data points, each consisting of a binary vector of 25 components, were clustered into four clusters. The percentage difference between the components of the reconstructed binary data and the original binary data was 20.7%.

Presentation No. 5

Nothing to add

(5)

Optimal Fourier domain data compaction for earth resources satellite data

Harvey F. Silverman

IBM, Yorktown Heights, N.Y.

It is well known that the enormous volume of data expected to be derived from the Earth Resources Technology Satellites (ERTS) will make the need for effective data compaction evident. The subset of data which contains the important information, however, will vary with application.

This paper proposes a scheme by which an ERTS user may optimally select his compacted data to fit his particular need. An extended performance index with arbitrary weights is shown to be a convenient means for mathematically describing an investigator's requirements. It is shown that selection of maximum amplitude points from a warped amplitude surface, based on this performance index, in the frequency domain yields these optimal results. Data from ESSA weather satellites is employed in the testing of the algorithm.

Presentation No. 6

The summary graphics accompanying this paper ~~was~~ were very unconvincing. Ponds, lakes, and roads showed up as wheat fields, four acre wheat fields as two acre pastures, wheat as corn, corn as oats, etc.

On the application of pattern recognition techniques to some remote sensing problems

K. S. Fu

Purdue University
Lafayette, Indiana

This paper discusses the application of pattern recognition techniques to the problems of classifying remotely sensed multispectral data. Problems treated include (1) feature selection, (2) classification, and (3) mode estimation and clustering. Distance-type criteria and feature-space transformation techniques have been applied to feature selection problems. The Bayes (or maximum likelihood) decision rule, polynomial discriminant functions, and the nonparametric sequential partitioning procedure have been tested for the classification problem. The implementation of these classifiers is also discussed. A statistical mode estimation procedure has been employed for estimating the number of modes in some of the pattern classes, and clustering techniques have been used to determine the field boundaries separating different classes. Experimental results from the classification of agricultural crops are used to demonstrate the applications. Extensions to other types of classification problems (e.g., soil testing) are discussed.

Presentation No. 7

Nothing to add

The use of correlated spectral imagery in two bands for extraction of agricultural information

Robert E. Kinzly and John E. Walker

Cornell Aeronautical Laboratory
Buffalo, N. Y.

The realization that the spectral reflectance of objects can provide information of value to image interpretation has led to accelerated development of multispectral remote sensing as a tool in the study of earth resources. The pattern recognition concept involved uses "spectral signature" for distinguishing between various classes of objects. Instrumentation to simultaneously collect data in more than twenty narrow spectral bands will soon be available.

Despite this interest in multispectral remote sensing, to date only a minimum amount of analysis has been conducted to establish: (1) a definition of the parameters measured in the sensing process, and the calibration required to reduce the parameters to meaningful "spectral signatures," (2) the trade-off between automatic pattern recognition techniques, interpreter assistance methods, and possible combinations of these two, and (3) the required number of spectral bands and their width. In this paper, we will address some of these questions.

Using a simple model for the ambient illumination and atmospheric effects, we previously demonstrated* that spectral reflectance of ground objects can be measured from photographic imagery to a precision of 7%. We will employ the model here to describe the data collected by a remote sensor and thereby define calibrations acquired to convert the measured parameter to object reflectance. Examples of calibration measurements in the visible region will be presented.

Some of our multispectral remote sensing studies have been oriented toward developing methods for presenting the data on an interpreter. We have found one useful presentation to be the "bi-band image" formed from two spectral images. The process for creating this image is discussed and several examples of its use for detecting plant health presented.

---

* F. B. Silvestro, "Multispectral Photographic Determination of Reflectance," Photogrammetric Engineering, 35, 258, 1969

Presentation No. 8

This is a working piece of hardware, but it is an extremely crude system. Motion pictures shown at the end of the paper show the GLOPR device painting a golay transform image on a CRT of a small portion of an airfield, and then successfully finding and highlighting a C-119 aircraft. This however, appears to be little more than a laboratory trick, because the aircraft was covering more than half of the CRT screen when it was located. The image is created on the screen by a square matrix having 128 lines on a side. In order for an object such as an aircraft to be rendered in such detail as to be differentiated, it must be using most of the 128 lines.

Applications of Golay hexagonal pattern transforms to aerial reconnaissance image processing

Kendall Preston, Jr. and P. E. Norgren

Perkin-Elmer
Norwalk, Conn.

The system discussed in this paper consists of the Golay Logic Processor (GLOPR) which is interfaced with various input scanners and a minicomputer. The software system has been written to allow the user to compile image processing procedures in Golay Logic Language (GLOL) and also permits the user to manipulate the scanners and GLOPR display from the teletype keyboard.

Presentation No. 9

Unfortunately, the authors of this paper showed no evidence to indicate the validity of their assumption that P.I. recognition data could be simulated. The net impression left is that this is a part of the P.I. process that cannot be simulated.

However, a member of the audience, a professor from the University of Kentucky, reported that a technique similar to this had been used by the University of Ohio to prove the feasibility of automatically scanning helicopter photos of traffic patterns. Using context, the cars were differentiated from the roadway by their shadows, and the car-shadows were differentiated from bridge, sign, and tree shadows because there was motion from one frame to the next. The technique was proved in theory to be capable of automatically singling out 49 cars out of 50. It was however, never put into practice, or even given a large scale test.

Presentation No. 10 - Westinghouse SLAR Aircraft

After the last paper on the first day, Westinghouse offered short tours of its computer facility and of its SLAR-configured aircraft. I chose to look at the aircraft.

The SLAR aircraft is a standard DC-6B with a 20-foot antenna pod suspended below the forward part of the fuselage. The radar pod is stabilized in three dimensions, and has a compartment at the rear which will accommodate an small aerial camera. The system is capable of acquiring SLAR imagery in the 50-foot range/50-foot azimuth resolution area. The plane has been in operation for several years and has flown mapping surveys under contract in Africa, South America, and various parts of Oceania.

Presentation No. 11 - Social Hour and Buffet Banquet

I was unable to attend the evening activities on 1 December. I was told the next day that the featured guest speaker, Brig. Gen. Robert T. Marsh, deputy for Reconnaissance and Electronic Warfare, Wright-Patterson AFB, decided not to appear at the last minute. Reportedly, when the General learned that the banquet was to be covered by Aviation Week, and that his remarks would have to be cleared in advance as a consequence, he sent a Col. Fredericks instead. Reportedly, Col. Fredericks remarks were appropriate to an audience including an Aviation Week reporter.

A context algorithm for pattern recognition and image interpretation

John R. Welch and Kenneth G. Salter

Philco-Ford
Willow Grove, Pa.

One method of interpreting aerial photographs is to divide a frame of imagery into square cells, to extract recognition data from each cell, and to classify one cell at a time according to statistical decision theory. This paper presents an algorithm for extracting contextual information from neighboring cells to improve cell recognition performance in such a system.

The algorithm was tested with a Monte Carlo technique which drew contextual information from real imagery but which simulated the recognition data. In the tests, the recognition error rate was reduced by as much as one half by the addition of context, and the amount of improvement was found to be largely independent of the parameters of the simulation.

Presentation No. 12

This is a working real-time system that uses standard photographic, radar, or infrared imagery as the source of data. In operation, a flying spot scanner plays over a standard 9" x 9" transparency in a random scan pattern. This produces a signal having a bandwidth of 56 HZ and an amplitude of 2-12 KHZ. The signal normally peaks at 4 KHZ but varies up or down in response to the texture of the terrain in the image. Thus the system can scan an image and differentiate between wooded terrain, orchards, urban areas, rice paddies, jungle, and water. An adaptive band-pass filter is capable of changing the frequency up or down in response to "training," thus the more imagery of a given set that is scanned, the more accurate the output.

The system requires only about a minute to scan a 9" x 9" frame, and is 84% accurate as measured against a human control.

In the question and answer period the briefer said that this system is not appropriate to finding objects; that to do that another type of scan would have to be chosen. The briefer also reported that the previously mentioned USGS radar photography of the Ashville Basin was scanned with this sytem and was classified in one minute with equivalent accuracy.

(12)

A learning system for terrain recognition

J. M. Idelsohn

Bendix, Southfield, Mich.

A system is described which automatically classifies terrain types from photography. Input is conventional panchromatic single-frame aerial photography of the earth. A flying-spot scanner converts this input to a time-varying video signal suitable for processing by the pattern recognition system. Processing consists of a series of analog and digital operations to arrive at a terrain classification based on spatial texture in the region of the input point. A learning strategy enables the system to refine its processing operations in order to improve classification performance with time. Test results are summarized.

Presentation No. 13

This is a very crude system. From the examples shown, this device appears to be a very poor cloud screener. When adjusted to differentiate P.O.L. tanks, the machine gives that identification to all round or near-round objects such as ponds, settling basins, etc. It will find a bridge if the photograph has first been masked to exclude all but the river. In spite of these deficiencies, present efforts are being devoted to miniturizing the equipment rather than improving it.

(13)

A hybrid computation system for pattern classification

R. D. Joseph and S. S. Viglione

McDonnell-Douglas
Newport Beach, Calif.

An interactive pattern recognition system is currently being developed for processing video imagery. The implementation selected by the authors uses an image dissector under computer control as the primary sensing device. The image itself, i.e., photograph, serves as the primary storage medium. The hybrid computation system is designed to operate in a laboratory environment in conjunction with a large digital computer (XDS 930) and associated peripheral equipment. The primary purpose of this system is to perform selected automatic photointerpretation tasks.

A control panel provides a function control to modify the system's operating mode, and numerous data access and display switches. The display panels include a viewer to examine the scene being processed, pattern category lights and numerical displays, and operating mode indicators. The data for classification experiments include both reconnaissance imagery, provided by RADC, and scientific satellite imagery, provided by NASA. A specific classification task is demonstrated using the NIMBUS weather satellite photographic imagery. The cloud masses are classificed and a simplified cloud map is generated where boundaries between cloud types are delineated.

A second classification task involves the identification of targets selected from the RADC recon imagery. Methods for deriving pattern features are discussed and performance on identifying targets such as bridges and tank farms is presented.

Presentation No. 14

Mr. Marshall was unable to attend the symposium. In his stead, Mr. Frank Kriegler presented the paper. Mr. Kriegler is the engineer on this University of Michigan project. Mr. Kriegler quickly showed himself to be unfamiliar with the graphics, unfamiliar with the use of a pointer and microphone, and generally, quite unfamiliar with the art of public speaking. Within five minutes he caused an impromptu coffee-break at the rear of the auditorium, and within ten he drove most everyone from the hall.

I stayed with Mr. Kriegler to the bitter end, but can add only the following: The U. of M. system will operate in 12-24 spectral bands, and will assist the following disciplines:

- forestry
- hydrology
- agriculture
- urban planning
- pollution detection
- fishing
- wildlife management
- range management
- watershed surveys
- geology
- oceanography

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Multispectral recognition techniques at the University of Michigan: present status and a planned hybrid recognition system

Robert E. Marshall and Frank J. Kriegler

University of Michigan
Ann Arbor, Mich.

Experiments with multispectral data have shown that it is possible to recognize many objects of interest to people in agriculture, forestry, urban study, water resources, pollution control, hydrology, etc. These data, coming from extensive areas, are very large and require high processing speed to keep pace with the data.

Present sensors such as the U. of M. scanner produce large amounts of data. Existing equipment cannot cope with the processing of all the data generated by these sensors. Planned sensors (ERTS, Skylab Scanner, NASA/Bendix Scanner) will be operating soon and will produce larger amounts of data as more and more large area surveys are made. If the development of processing techniques and equipment were postponed until the data became available, a lag of several years could result and seriously bottleneck progress.

Further development is necessary. Present techniques developed at Michigan have solved the problem of keeping pace with the desired rate of recognizing objects in "real-time". Three additional problems have been identified:

1. Setting up a processor such as the Michigan Processor (SPARC) requires considerable time. This time needs to be reduced.
2. Determination of an "optimum" setup cannot be done quickly or practically using such a processor by itself.
3. On-line modification of the processing rule to account for natural variation seems necessary and requires

computation which cannot be performed with an analog machine.

A solution to these problems is proposed and discussed in this paper. The approach is to add an interacting digital machine to the system and reconfigure the analog machine design to be compatible with the digital system. The strength of our approach lies in the fact that algorithms have been developed which make effective use of the particular capabilities of the two computers working together on a highly interactive basis.

Study is still required to modify and develop these algorithms further for the digital machine and to determine the effectiveness of the man-machine interface. Study and specification of the final configuration needed for operational use can be pursued using this system as a tool.

Presentation No. 15

The OLPARS is a computer hardware/software system whose application thus far has been limited to the recognition of hand-written characters. The system incorporates several advanced features: all instructions are entered at the console using a light gun; two-dimensional histograms are produced on the CRT but they are rotatable, making them three dimensional presentations. The presentation, while well delivered, was quite complex. I suspect that more than a few were unable to follow the quick progression of programming flow charts describing the OLPARS system. This was the only system to end on time and receive no questions or comments from the floor.

(15)

Interactive pattern recognition

John W. Sammon and Bruce K. Opitz

Computer Symbolic
Rome, N. Y.

This paper describes the application of on-line interactive graphic techniques to the general pictorial pattern recognition system. The pictorial recognition problem is decomposed into the tasks of search, feature extraction, and finally, pattern classification. An on-line interactive graphics system is described which permits the pattern recognition researcher to design and test both search algorithms and potentially useful features. Specifically, this system is comprised of three subsystems. The first provides a wide variety of preprocessing options which can be applied to digitized pictures and viewed on a grey level display. The second subsystem contains flexible tools for interactive design and evaluation of searching algorithms. The last major subsystem gives the on-line user the ability to design features by construction of functions of the neighborhood of a point. This subsystem also provides limited feature evaluation capability.

In addition to the Feature Extraction System, the On-Line Pattern Analysis and Recognition System - OLPARS - will be described. OLPARS is a large interactive graphics system which has been implemented to solve complex pattern classification problems. The application of OLPARS to the design of a recognition system capable of reading unconstrained handprinted alpha and numeric characters will be presented as an example of the potential utility of the interactive approach to pattern classification.

Finally, the concept of using interactive software systems for the design and evaluation of searching algorithms and features will be discussed. Timing and storage considerations will be considered and shown to be within acceptable bounds for a software interactive system.

Presentation No. 16

Honeywell is developing this real-time target screening device for the U.S. Air Force. Development is well along, and delivery is scheduled for January 1972. When perfected, the device will be installed in a multi-engined gunship. Later, a miniaturized version will be put into an F-4.

The Honeywell device scans infrared imagery in real-time and presents potential targets to the human operator for final decision. If the nature of the terrain and the false-alarm rate so dictate, the device may be switched from the normal low clutter mode to the high clutter mode. The device recognizes targets by being made sensitive to edges, straight lines, and certain pre-defined threshholds of tonal variation and tonal evenness.

Many details of this system were lacking in the presentation, possibly because their inclusion would have required that the talk be classified.

(16)

Automatic target screening in reconnaissance systems

George D. Swanlund and Leonard Kirvida

Honeywell, St. Paul, Minn.

A flyable automatic target screener is being developed. It will direct the operator's attention to likely targets. He will then decide if, indeed, it is a target.

In this paper we summarize past efforts, define the operator's needs and describe the current target screener development. The screening logic and implementation approach are discussed.

Presentation No. 17

This is a computer software system that uses a variety of input and output hardware, depending on the task at hand. The system will accommodate TV imagery, infrared, SLAR, and conventional photography that has first been digitized. The system will accommodate variations in color, size, orientation, and background clutter. In operation, the system submits imagery to a line-by-line scan one microsecond per resolution element in duration (a TV image would thus be scanned in 0.4 seconds). The following are recent applications of this Westinghouse system:

1. Stern-view silhouettes of fighter aircraft were presented at the small scale normally seen by a pilot in an air-to-air combat situation. The device was able to correctly identify 90% of the silhouettes.

2. Aerial photography was scanned for the purpose of picking out elliptical-shaped piedmont bays from the surrounding landforms. The device had good success.

3. In a recent application for Johns Hopkins, the device was linked to a microscope for the purpose of acquiring elliptical-shaped cancer cells in vivo (real-time in live tissue), and tracking their movements.

In the question and answer period that followed, Dr. Tisdale said that one of the more interesting potential uses of this system is for the automatic registration of the same object or area on multiple-sensor coverage. Since this device can accommodate different orientations and scales, an otherwise difficult orientation problem can be done almost instantaneously. Currently, the device is being applied to a study of SLAR-imaged landforms in the Los Angeles area.

Presentation No. 18

Just prior to the beginning of the final afternoon session, Westinghouse demonstrated their most recent low-light-level television tube. The device imaged a staticly displayed photograph with great clarity in a room in which all lights had been turned off, even the exit signs.

Applications of a digital image processing system

Glenn E. Tisdale

Westinghouse
Baltimore, Md.

A five-year program at Westinghouse has resulted in the development of a computer software system for image processing and recognition. The system has been applied to such problems as the acquisition and tracking of targets, target identification, and the registration of separate images of the same scene. The paper will discuss the operation of the system in performing these functions.

Characteristics of the system include the ability to accept inputs from a variety of sensors, or combinations of them; line-by-line processing of the image so as to reduce storage requirements and increase processing rates; and operation in a manner which is tolerant of relative position, orientation, and scale, as well as partial target obscuration or background clutter. The system is planned for eventual incorporation in a compact special-purpose digital processor, operating at overall rates in excess of one picture element per microsecond.

An important function is the ability to register separate images of the same scene. This function is similar to area correlation, in which individual picture elements are matched, but it is potentially faster and more flexible. For example, registration can be carried out independent of the relative orientation of the two images, over a wide range in relative scale, or even if the images are obtained from sensors in different frequency bands. Once the images are registered, changes between them can be readily detected. The use of context information developed by the processor can assist in the elimination of false alarms.

Presentation No. 19

Mr. Scheps, who presented this paper, is the U.S. Army engineer topographic laboratory's liaison officer to ERTS/EROS.

An urgent requirement developed in 1969 for the accurate location of all the non-visible sand deposits in the Mekong Delta. There was plenty of visible sand, but because it formed the dry, well drained ridges upon which most of the delta villages were built, it was not usable. What was needed was the concealed sand that could be mined and used for priority construction projects. A ground survey was impossible due to the ubiquitous Viet Cong.

At the request of the Chief of Engineers a multi-discipline task team was formed and a plan of action drawn. In response to the plan, photo indexes were made, maps were accumulated, horizontally and vertically polarized SLAR was flown, color and thermal infrared was flown, and black and white, color, and multiband photography was acquired, the latter using a Bendix nine-channel scanner.

The often subtle clues from all these sensors were used in combination to locate all the sand in the search area within two months time.

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Image analysis for a real terrain analysis problem - state of the art capability and progress toward automation

E. G. Barnes, F. G. Capece, L. P. Murphy, D. G. Orr, and B. B. Scheps

U.S. Army Engineer Topographic Laboratories, Ft. Belvoir, Va.

A real requirement and problem requiring terrain analysis in a multisensor situation is given as the background for development of ideas - a typical complex terrain factor analysis situation. Against this real problem background is developed the state-of-the-art (mostly skilled human photointerpretation). A discussion is presented of progression of semi-automated and automated developments in various stages of completion designed to handle complex and frequently multi-image analysis problems in an interactive mode. The eventual capability of such systems to also format output into products for an image data base and operate on data base materials to synthesize answers to user questions will also be described as a related image processing concept.

Presentation No. 20

Dr. Strasser chose as his primary theme to take issue with the terminology of pattern recognition, and secondarily to take issue with many of the terms used and points made by previous speakers. His analogies seemed simplistic, and his generalizations overdrawn. He was not entirely successful in his announced intention of not irritating anyone with this line of approach.

Somewhat more memorable was Dr. Strasser's retelling of an Amram Katz joke about a tank of fish aboard a Navy ship during the 1947 Bikini tests. If this is new to anyone, I will be glad to repeat it--verbally.

Airborne target recognition -- concepts and practice

Robert A. Strasser

Air Force Avionics Laboratory
Wright-Patterson Air Force Base, Ohio

An airborne operator needs assistance in finding military targets in today's aircraft environment. Pattern recognition techniques may be the answer. In an airborne target recognition system, the man-machine relationship must be designed to take full advantage of the inherent capabilities of each. Man has a firm position in the decision loop in the foreseeable future. Research and development in this field as well as service use should be a progressive program.

Some current contracted and in-house efforts are briefly described.

Presentation No. 21

Wearing another hat, Mr. Thomasson is part of the LITTON Systems crew presently installing the automatic target recognition device in IEG/PHD.

In his paper, Mr. Thomasson explained that a holographic filter will recognize whatever shape or object it is masked for--as long as the shape or object is oriented in the same direction. An object might be recognized in several orientations if the mask has been rotated and re-photographed on the filter. Using standard re-photographing techniques, however, causes the density of the filter to increase markedly with each exposure.

A new technique, involving the bleaching of the filter with Pakasol, permits the number of exposures to be greatly increased without increasing the density. A filter created by the latter process, having 36 masks each separated by 10^{o} of rotation, will recognize a shape in any orientation.

By placing different masks in the four corners of the filter rather than just one mask in the center, the filter may be "multiplexed" for four different shapes or objects. Theoretically, a filter may be multiplexed to recognize eight or even 12 different objects in all orientations.

Multiplexed holographic filters

James Thomasson

Litton Systems
Van Nuys, Calif.

Multiplexed holographic filters record more than one signal. They can be used to search for more than one target simultaneously, thus increasing the processing speed of an automatic recognition system.

Filter-making, bleaching, and search techniques are described along with experimental results. The work was performed under the Optical Target Detection Study Program for RADC (AF 30602-69-0208).

Presentation No. ~~21~~ 22

Nothing to add.

Detection of texture edges

Azriel Rosenfeld

University of Maryland
College Park, Md.

A set of simple parallel operations is described that can be used to sharply detect edges between adjacent regions on a picture that have different textures; it is assumed that such regions differ with respect to the average value of some local property P. By computing P over the picture, the textural difference between the regions is first converted into a difference in average gray level. Operations are then applied to the resulting picture which compute, at each point, differences in average gray level between pairs of touching neighborhoods on opposite sides of the point in various orientations. A "best" such difference is found and taken to be the edge value at the point. Examples are given of the application of this approach to texture edges resulting from differences in average gray level, in "coarseness", and in "directionality".